

AIRS Products Explain the Close Relationship between OLR Anomalies and the El Niño Index

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NASA GSFC Sounder Research Team
AIRS Science Team Meeting

April 24, 2012
Pasadena, CA



Outline

- Comparison of AIRS and CERES anomaly time series of OLR
- Explanation of recent decreases in global and tropical mean values of OLR
- Data Sets Used
 - o AIRS Science Team Version-5 monthly mean data obtained from Goddard DISC (level-3)
OLR, T_{skin} , q_{500} , cloud fraction
Data products extend to March 2012
 - o CERES Science Team monthly mean data obtained from Langley ASDC
CERES Terra EBAF (Energy Balanced And Filled) Edition 2.6r
Data products extend to June 2011
 - o AIRS/CERES comparisons are done for the period September 2002 through June 2011

Definition of Anomalies, ARC's and ENC's

Eight-year monthly climatologies were generated for each grid box by averaging data for eight Januaries, eight Februaries,

The monthly anomaly for each grid box is the difference of the monthly mean value for that month from its climatology

The Average Rate of Change (ARC) for a grid box is the slope of the straight line passing through the monthly anomaly time series

Values of ARC's depend on the extent of the time series used

Spatial patterns are more important than precise values

An area mean ARC is the cosine latitude weighted average ARC over the area

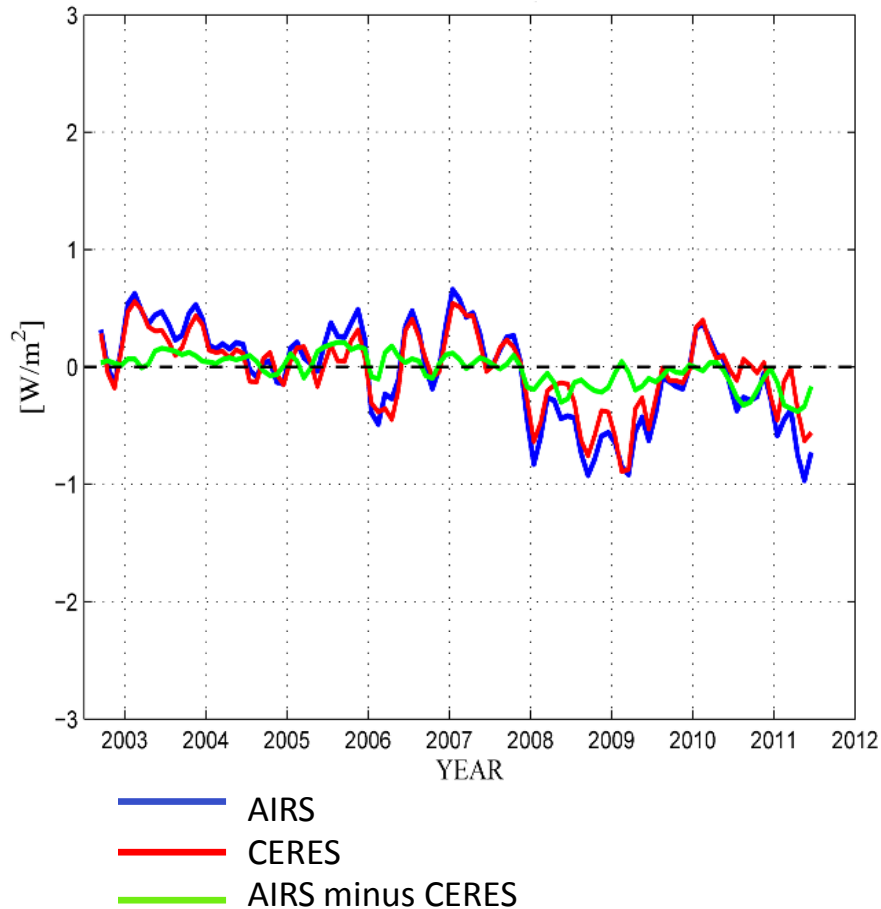
The El Niño Correlation (ENC) for a given grid point is the temporal correlation of the anomaly time series for that grid point with the El Niño Index. ENC's should be less time period dependent



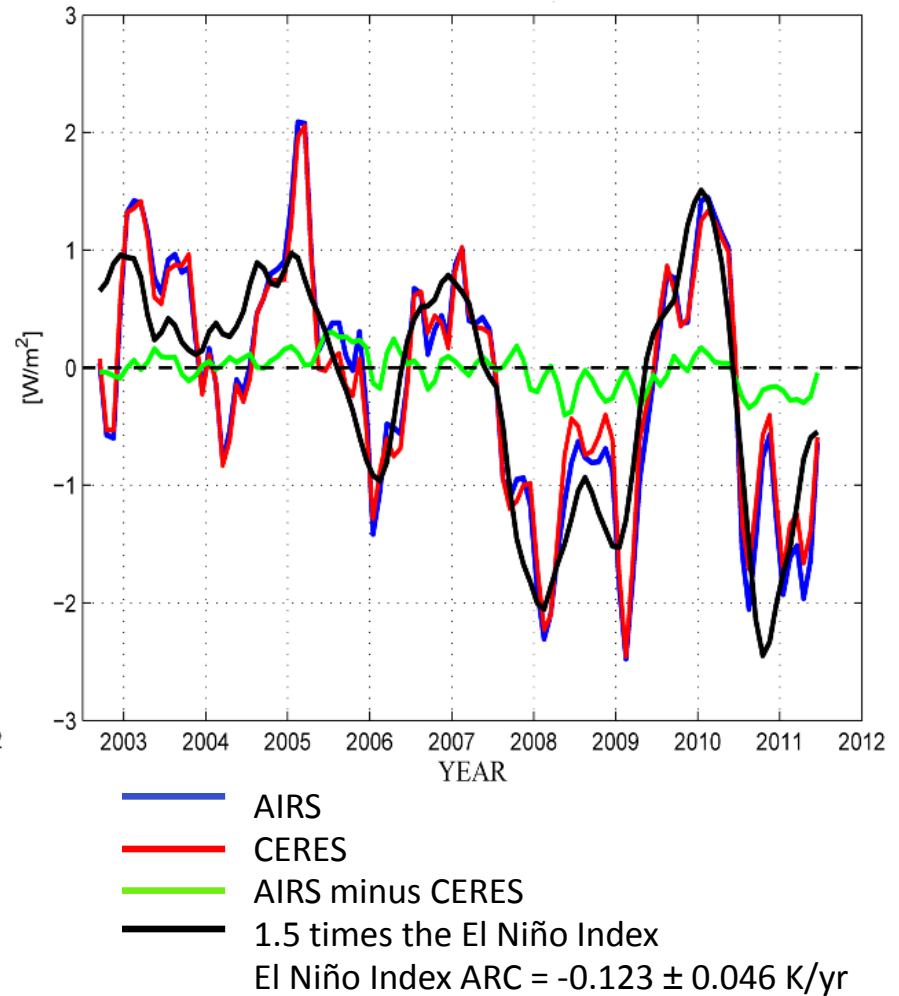
OLR Anomaly Time Series

September 2002 through June 2011

Global Mean



Tropical Mean



OLR Anomaly Time Series Comparison

September 2002 through June 2011

Data Set	Global	Tropical
AIRS ARC (W/m ² /yr)	-0.094 ± 0.026	-0.183 ± 0.070
CERES Terra ARC (W/m ² /yr)	-0.059 ± 0.022	-0.154 ± 0.066
AIRS Minus CERES STD (W/m ²)	0.136	0.155
AIRS/CERES Correlation	0.955	0.991
AIRS ENC	0.587	0.830
CERES ENC	0.523	0.813

AIRS and CERES global mean and tropical mean anomaly time series agree very closely with each other

Both show that global, and especially tropical, mean OLR have decreased over the time period under study

Important Highlighted Regions in Subsequent Figures

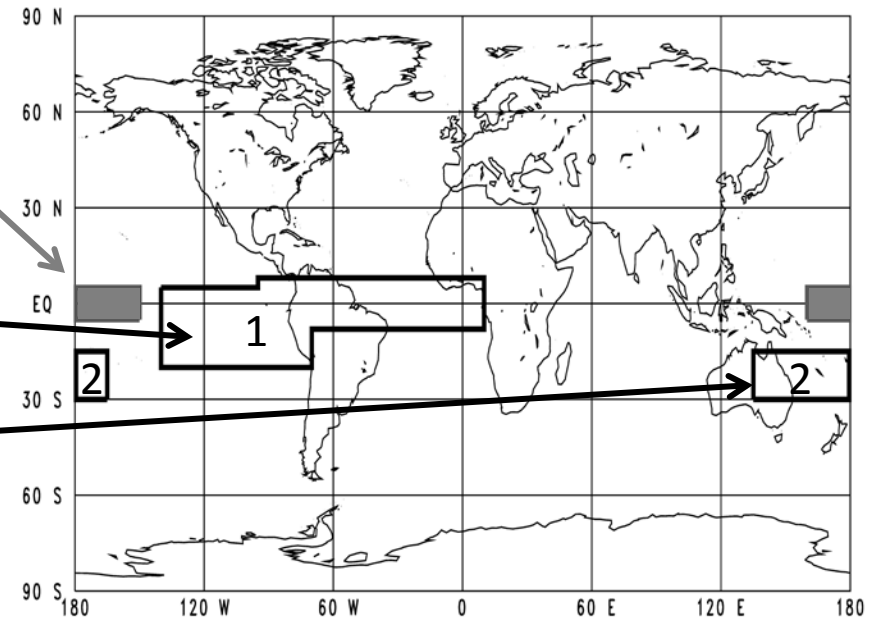
NOAA Niño-4 Region: We define the El Niño Index as the NOAA monthly mean T_{skin} anomaly averaged over the NOAA Niño-4 region 5°N to 5°S, 150°W, westward to 160°E

2) OLR Region 1:

West of El Niño region

3) OLR Region 2:

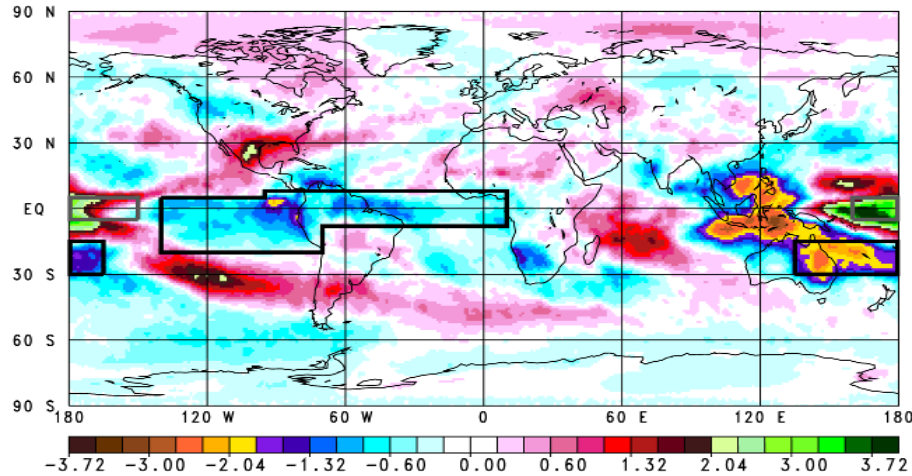
South/Southwest of El Niño region



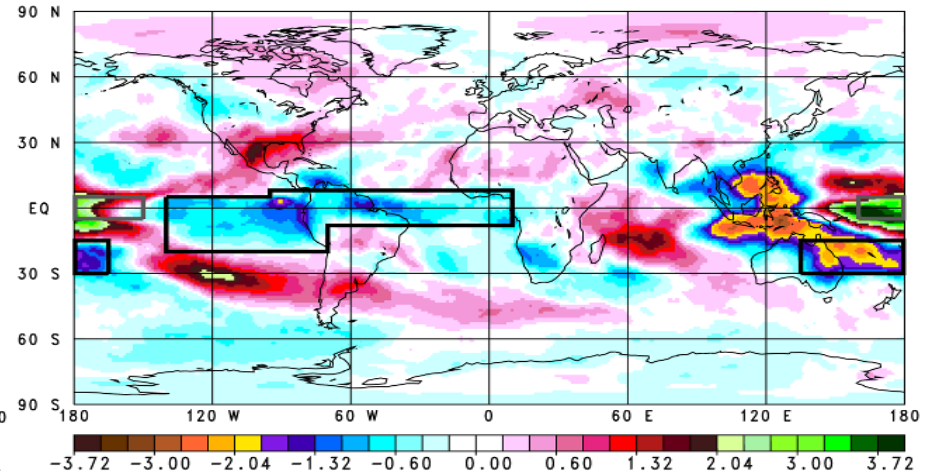
OLR Regions 1 and 2 encompass key features shown in subsequent figures

September 2002 through June 2011

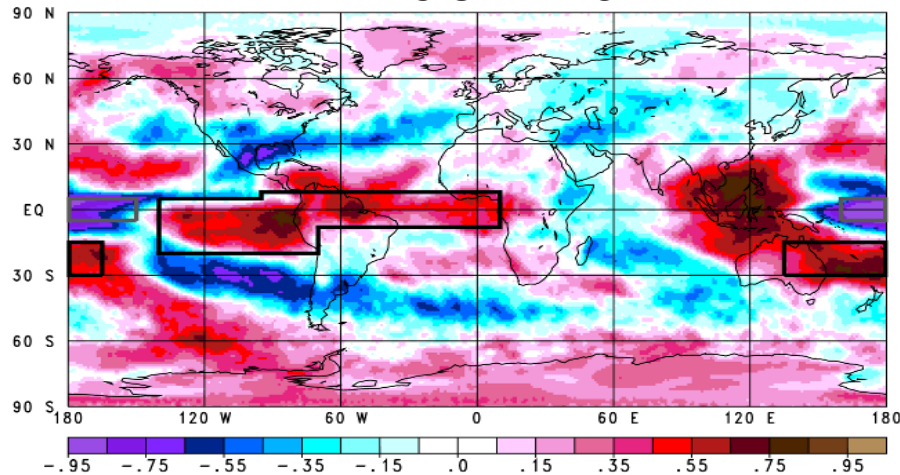
AIRS OLR ARC



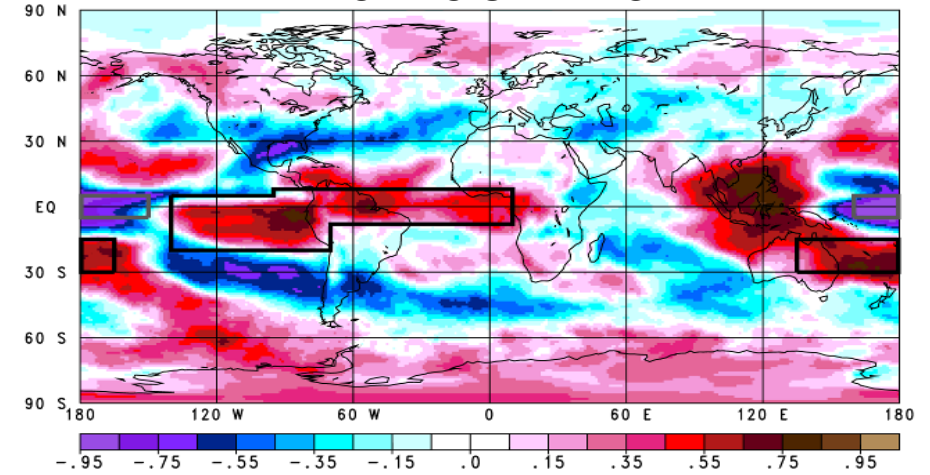
CERES OLR ARC



AIRS OLR ENC



CERES OLR ENC



OLR ARCs are very negative over Regions 1 and 2

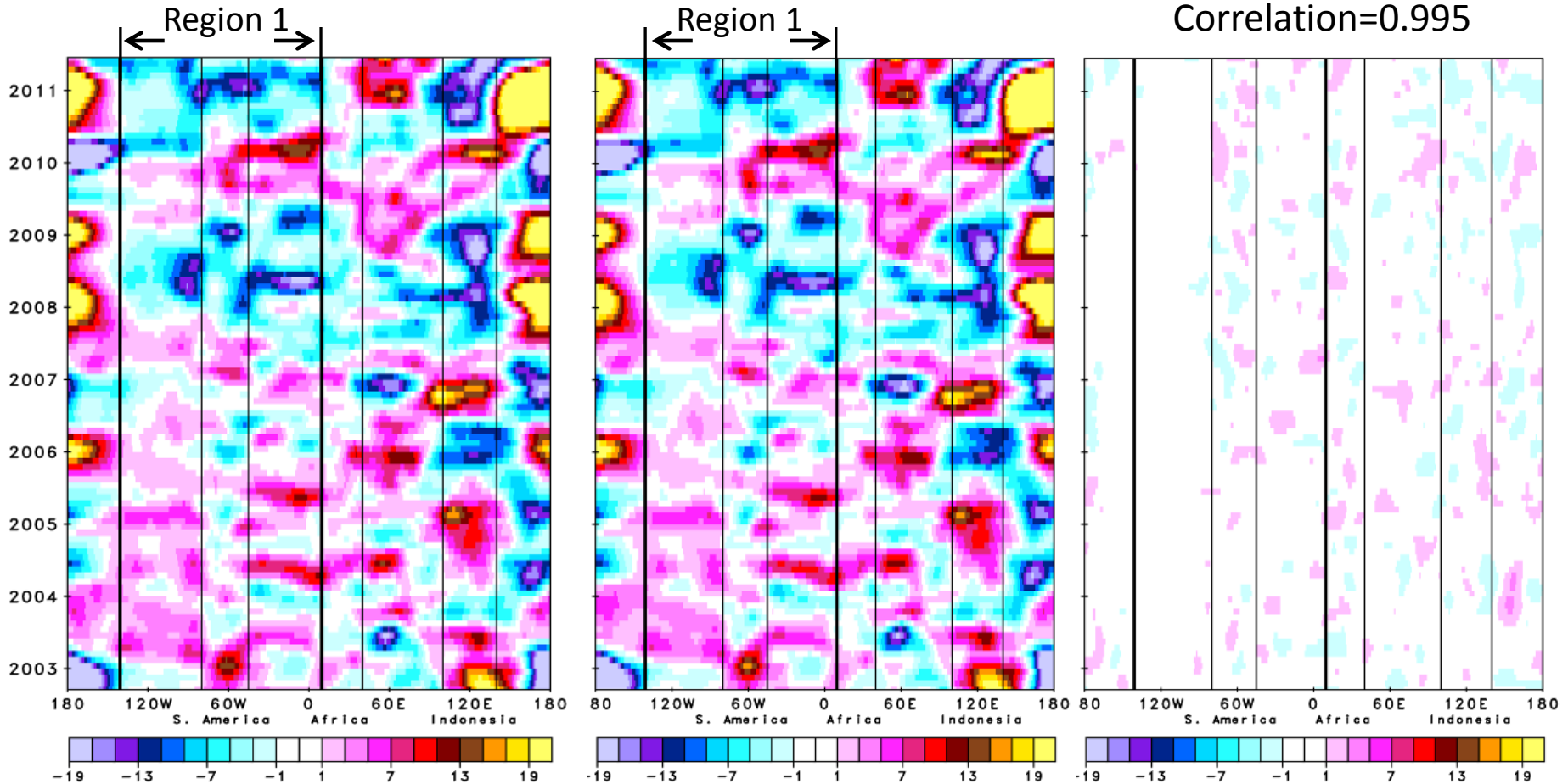
OLR ENCs are very positive over Regions 1 and 2

OLR Anomalies Tropics 5°N to 5°S Monthlies, September 2002 through June 2011

AIRS

CERES

AIRS minus CERES
Correlation=0.995

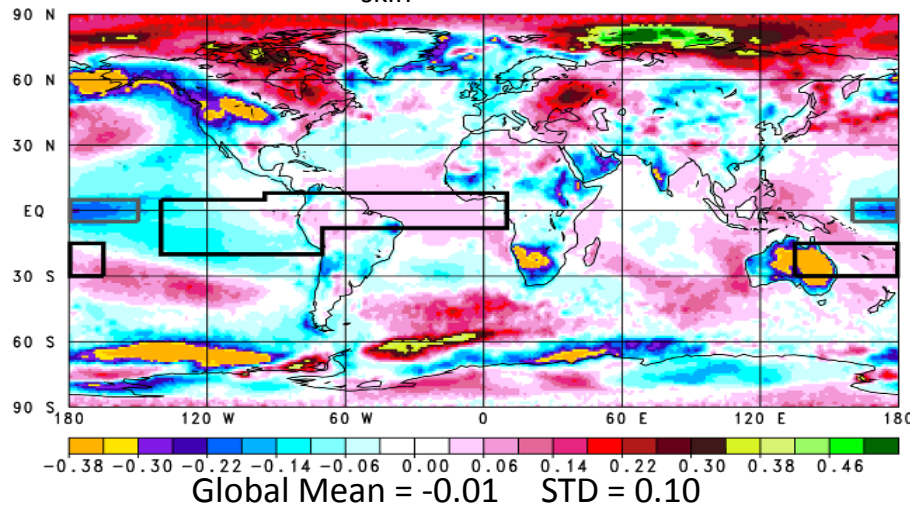


Equatorial OLR anomalies near the dateline are roughly equal, and of opposite sign, to those over Indonesia

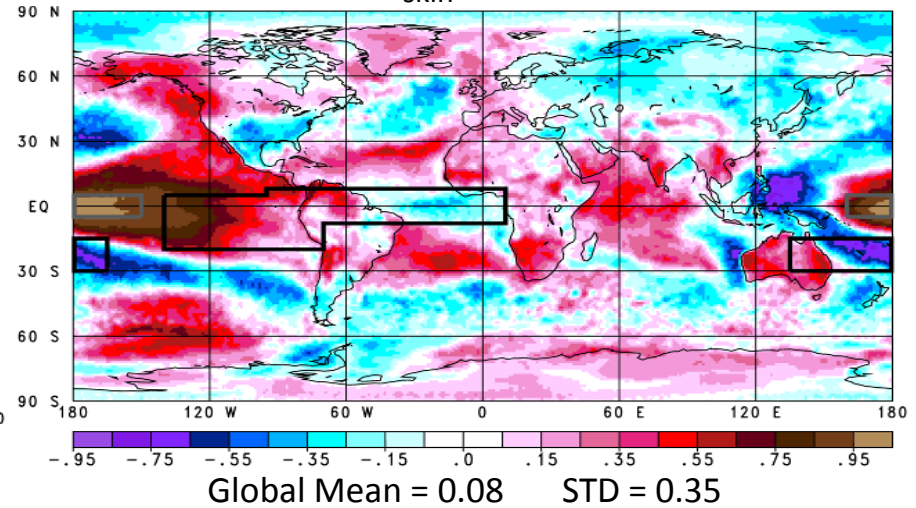
Equatorial OLR anomalies within Region 1 are smaller than, and of opposite sign to, those near the dateline but are uncompensated for

AIRS Products September 2002 through June 2011

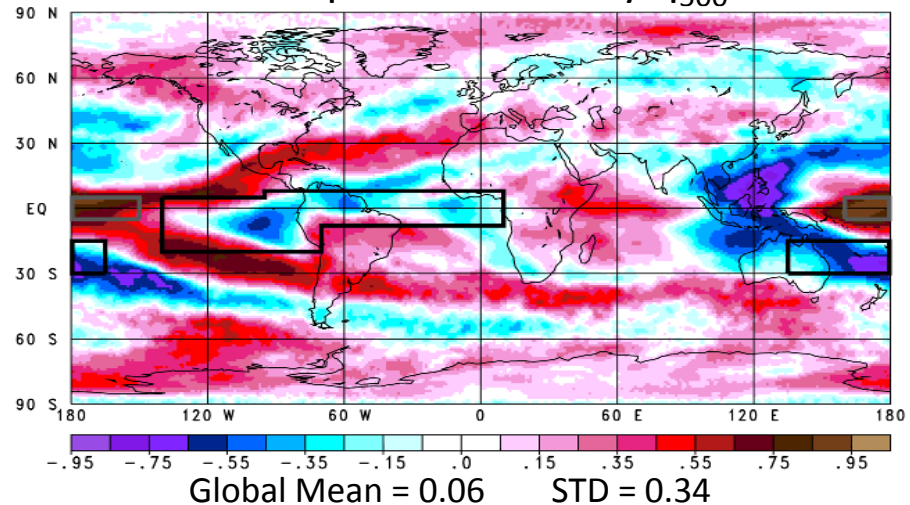
T_{skin} ARCs (K/yr)



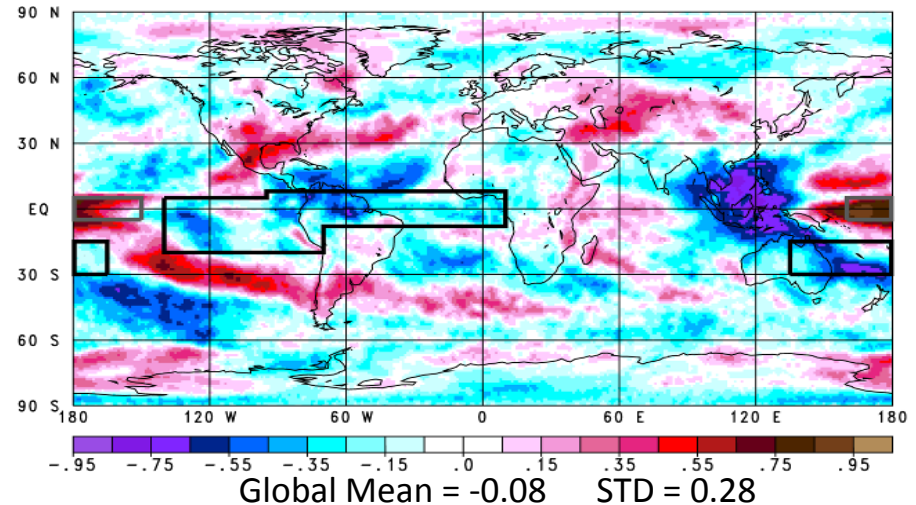
T_{skin} ENCs



500 mb Specific Humidity q_{500} ENCs



Effective Cloud Fraction α ENCs



T_{skin} ARCs and ENCs are for the most part of opposite sign. This shows most ARCs are El Niño driven, except near the North Pole

ENCs of q_{500} and α are similar to each other and are both very negative over OLR Regions 1 and 2

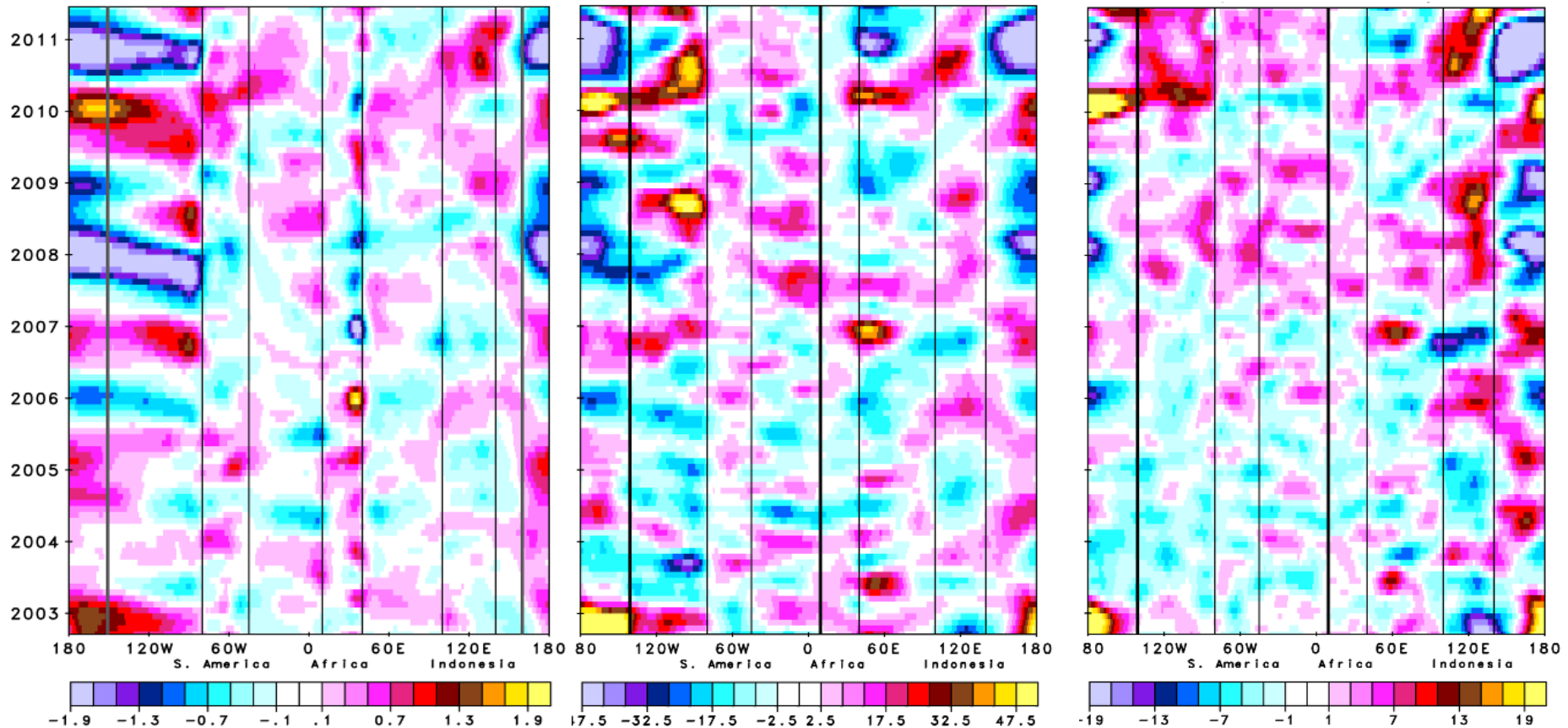
AIRS Anomalies Tropics 5°N to 5°S

Monthlies, September 2002 through June 2011

T_{skin} (K)

q_{500} (%)

α (%)



α and q_{500} anomalies are in phase with those of T_{skin} near the dateline and over Indonesia

α and q_{500} anomalies in Region 1 are often out of phase with those at the dateline

	AIRS		CERES	
Spatial Area	OLR ARC (W/m ² /yr)	OLR ENC	OLR ARC (W/m ² /yr)	OLR ENC
Region1	-0.631 ± 0.158	0.767	-0.611 ± 0.154	0.761
Region 2	-1.660 ± 0.348	0.818	-1.534 ± 0.348	0.825
Global without Region 1	-0.044 ± 0.020	0.256	-0.011 ± 0.019	0.039
Tropical without Region 1	-0.037 ± 0.048	0.599	-0.011 ± 0.047	0.511
Global without Region 1&2	-0.011 ± 0.021	-0.098	0.021 ± 0.020	-0.331
Tropical without Region 1&2	-0.005 ± 0.045	0.468	0.022 ± 0.044	0.362

Summary

Recent AIRS and CERES OLR anomaly time series are in very close agreement on a 1° spatial scale

Both show a significant decrease in global mean and tropical mean OLR over the period September 2002 through June 2011

The degree of agreement is remarkable but the recent OLR decrease is not because it is the result of a transition from El Niño conditions to La Niña conditions

The recent decrease in global and tropical mean OLR results from the very large negative correlations of water vapor and cloud cover in OLR Regions 1 and 2 with the El Niño Index

Global and tropical mean OLR anomaly time series evaluated outside of Regions 1 and 2 show very little change over the period September 2002 through June 2011

My Version-6 validation talk on Thursday shows AIRS Version-6 OLR will agree even more closely with CERES OLR in terms of both absolute value and spatial anomaly trends

